Space Science Mission Operations Project (Code 444)

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AGENDA

- Organization overview
- Mission Set
- Space Link Extension (SLE)
- SSMO Bulk Buy (USN)
- Goddard Mission Services Evolution Center

Organization Overview

Space Science Mission Operations Project

Charter

- SSMO has management responsibility for the safe and productive operations of Goddard Space Flight Center Space Science missions in the operations phase and for selected GSFC instrument operations on non-GSFC managed spacecraft operations
- SSMO works with missions in the development phase to feedback lessons learned and to ensure that operations concepts are sustainable
- SSMO works with the GSFC Mission Services Evolution Center (GMSEC) to ensure that the mission services infrastructure is kept current, and that technology development and infusion efforts are integrated with mission needs

Operations Philosophy

- Mission safety is the number one priority
- Goal is to maximize science data collection within budget and risk constraints

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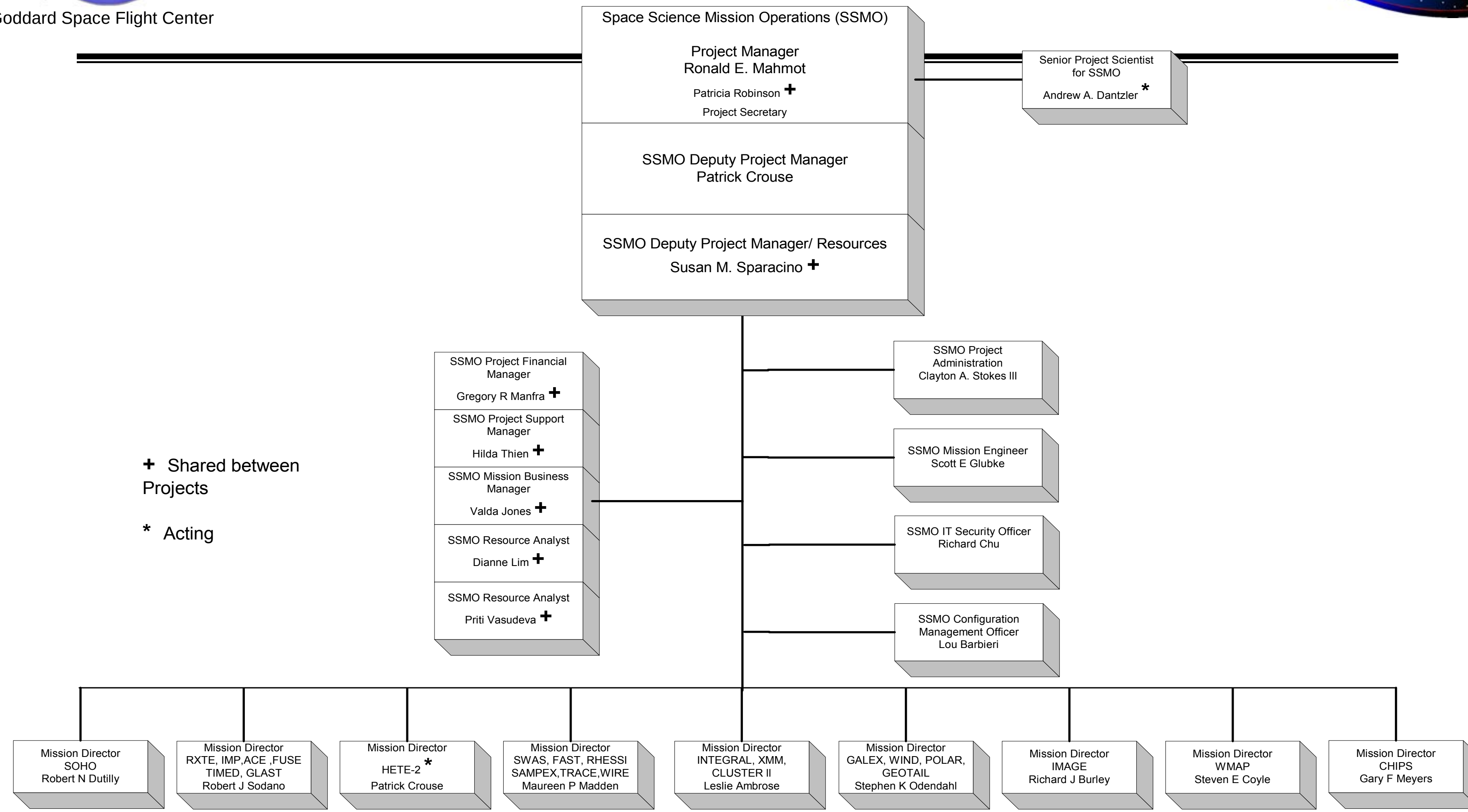
Organization Overview



Original signed by **August 7 2003**

Ronald E Mahmot, Space Science Mission Operations Project Manager **Date**

Mission Set
Mission Parameters

SPACECRAFT	LAUNCH DATE	BASE/ EXTENDED MISSION	EARLIEST REENTRY	Reentry Analysis Completion Date	Would uncontrolled reentry result in greater than 1 in 10,000?	NUMBER OF INSTRUMENTS	NUMBER OF INSTRUMENTS OPERATING	ORBIT
Yohkoh	8/31/1991	Dec-01	Mar-05	Dec-03	TBS	4	0	570 x 730 km @ ?
ROSAT	6/1/1990	Feb-99	Mar-06	Dec-03	TBS	2	0	539 x 554 km @ 53°
WIRE	3/5/1999	Mar. 99	Oct-07	Dec-03	No (5.8 m2)	1	0	540 km @ 97°
SAMPEX	7/3/1992	Sept. 95	Jul-09	Dec-03	No (1.4 m2)	4	4	550 x 675 km @ 82°
CLUSTER II	7/00 & 8/00	Feb. 01 & Dec. 05	2009/2010	Dec-03	TBD	4 (US)	4 (US)	3 Re x 18.5 Re Orbit @ 90°
RXTE	12/30/1995	Mar. 97	Sep-10	Dec-03	**Yes (44.1)**	3	3	565 x 583 km @ 23°
CHIPS	1/12/2003	Oct. 03	Nov-10	Dec-03	No (6.1 m^2)	1	1	600 km @ 94° inclination
RHESSI	1/24/2002	Mar. 04	Apr-11	Dec-03	**Yes (18.2)**	1	1	600 km @ 38° inclination
TRACE	4/2/1998	Jun. 00	Jul-18	Dec-03	No (6.7 m2)	1	1	600 x 650 km @ 97°
TIMED	12/7/2002	Jan. 04	Oct-24	Dec-03	**Yes (9.2)**	4	4	625 km @ 74.1°
COBE	11/19/1989	N/A	Jul-29	Dec-03	TBS	3	0	874 km @ 99°
FAST	8/21/1996	Oct. 99	Jul-29	Dec-03	No (1.2)	5	5	4150 x 348 km @ 83°
SWAS	12/2/1998	Feb. 00	Jul-29	Dec-03	No (?)	1	1	600 km @ 70° inclination
FUSE	6/24/1999	Mar. 07	Jul-29	Dec-03	No	1	1	775 km @ 25°
HETE-2	10/10/2000	Sept. 03	Jul-29	Dec-03	No (<1 m2)	3	3	625 km equatorial orbit
XMM	6/30/2001	?	Jul-29	TBD	TBS	2	2	7000 x 1114000 km @ 40°
GALEX	4/28/2003	Sep. 05	Jul-29	Dec-03	TBS	1	1	690 km equatorial orbit
Geotail	7/24/1992	Sep. 06	Centuries	Dec-03	N/A	7	6.5	8 x 210 Re equatorial
WIND	11/1/1994	Sep. 07	Centuries	Aug-03	N/A	8	7.4	L1 Orbit
POLAR	2/24/1996	Sep. 05	Centuries	Dec-03	N/A	12	10	2 x 9 Re @ 86°
IMAGE	3/25/2000	Sept. 03	Centuries	Dec-03	N/A	6	6	1000 x 45922 km @ 90°
SOHO	12/2/1995	Jan. 99	Never	Aug-03	N/A	12	12	L1 Orbit
ACE	8/25/1997	Sept. 07	Never	Dec-03	N/A	9	8.5	L1 Orbit
WMAP	6/30/2001	Aug. 05	Never	Dec-03	N/A	1	1	L2 Orbit
INTEGRAL	10/17/2002	Oct. 07	?	?	TBS	4	4	9000 x 155000 @ 51.6°

as of 6/8/2004

Mission Set
Future Missions/Strategic Planning

- Established Memorandums of Agreement with Explorers, Solar Terrestrial Probes, and Living with a Star. Structure and Evolution of the Universe agreement is pending SEU final approval
  - **Involve operations early in the project life cycle (operations concept development, trade studies, best practices/lessons learned)**
  - **Communicate SSMO requirements and criteria for successful transition**
  - **Facilitate maintenance and evolution of operations infrastructure**

- Working with the GSFC Mission Services Evolution Center (GMSEC) to ensure that the mission services infrastructure is kept current, and that technology development and infusion efforts are integrated with mission needs

- Some missions of particular interest:
  - **Swift – Penn State operations/DAS user – October '04**
  - **STEREO – 2 satellites 3D Imaging of Coronal Mass Ejections (CMEs) – '06**
  - **THEMIS – 5 satellites, 3-4 different orbits, UCB operations – '06**
  - **GLAST and SDO – GSFC-based operations - '07-'08 timeframe**
  - **MMS – constellation operations -'12**

Current Mission Set Guidance

Mission set updates per Office of Space Science guidance

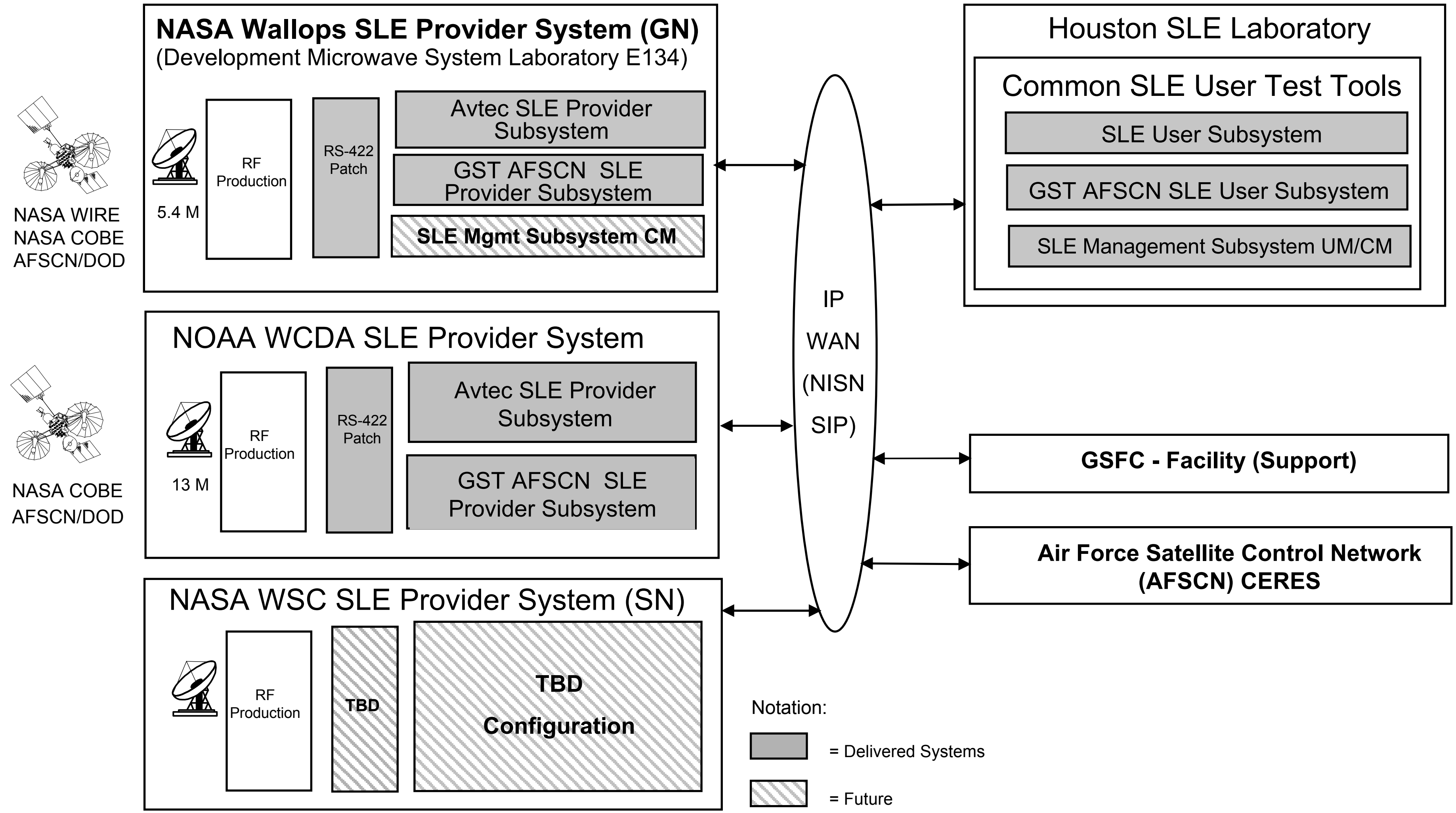
SWAS and SAMPEX terminate science operations in FY04 per the Senior Reviews held in 2002 for Astronomy & Physics and 2003 for Sun Earth Connections

WIND (05), FAST (05), TIMED(06), AND TRACE (06) plans reflect earlier than expected end dates per HQ direction, pending restoration of budget

Senior Review 2004 for Astronomy and Physics MO&DA programs is in progress

- WMAP, CHIPS, GALEX, HETE-2, INTEGRAL, XMM, RXTE, FUSE
- Guidance is expected in July 2004

SLE Testbed Architecture



SLE Testbed Accomplishments

- **Implemented a distributed SLE testbed infrastructure**
- **Testing showed SLE supports CCSDS, TDM and Bitstream space links**
  - Conducted successful SLE Tests using NASA WIRE **CCSDS** Satellite via the NASA WFF 5.4 m station
  - Conducted successful SLE Tests using NASA COBE **TDM** Satellite using both the NASA 5.4 m station and the NOAA WCDA 13m station
  - Air Force conducted 17 successful tests with the NASA Wallops 5.4 m station using the DOD Test and Checkout (TACO) satellite TSX-5 **(Bitstream)**
  - Air Force conducted successful downlink and SLGS Uplink (Commanding) through NOAA WCDA ground station
- **Tested the JPL developed SLE products and the Avtec PTP SLE system against CCSDS SLE RAF, RCF, and CLTU specifications**
- **SLE testbed made significant contributions towards a more mature vendor provided SLE Transfer Services product**

SOHO/Space Link Extension (SLE)

- SSMO agreed to eliminate use of 4800 BB communications with DSN
- DSN and ESA currently use SLE to facilitate interoperability
- SOHO SLE development effort underway
  - Supports access to JPL/DSN stations
  - Enables interoperability with ESA ground stations like New Norcia
  - Provides security layer to ensure authorized connections
  - TCP protocol rather than UDP protocol provides assured delivery
  - Creates a pathway to retire legacy equipment supporting the NASCOM interface

SOHO/SLE Application Programmers Interface

Before SOHO/SLE team design work began, evaluated multiple SLE API products including:

- NASA/JPL source code
- Anite SLE API COTS product (ESA)
- Vega (UK)
- GST (US)
- Avtec

Chose the Anite SLE API product and is requiring its use for this project for the following reasons:

- The Anite SLE API is a COTS product with available customer support.
- The NASA/JPL and ESA/Anite SLE APIs were created as a cooperative effort between the two agencies.
- Anite supports UNIX

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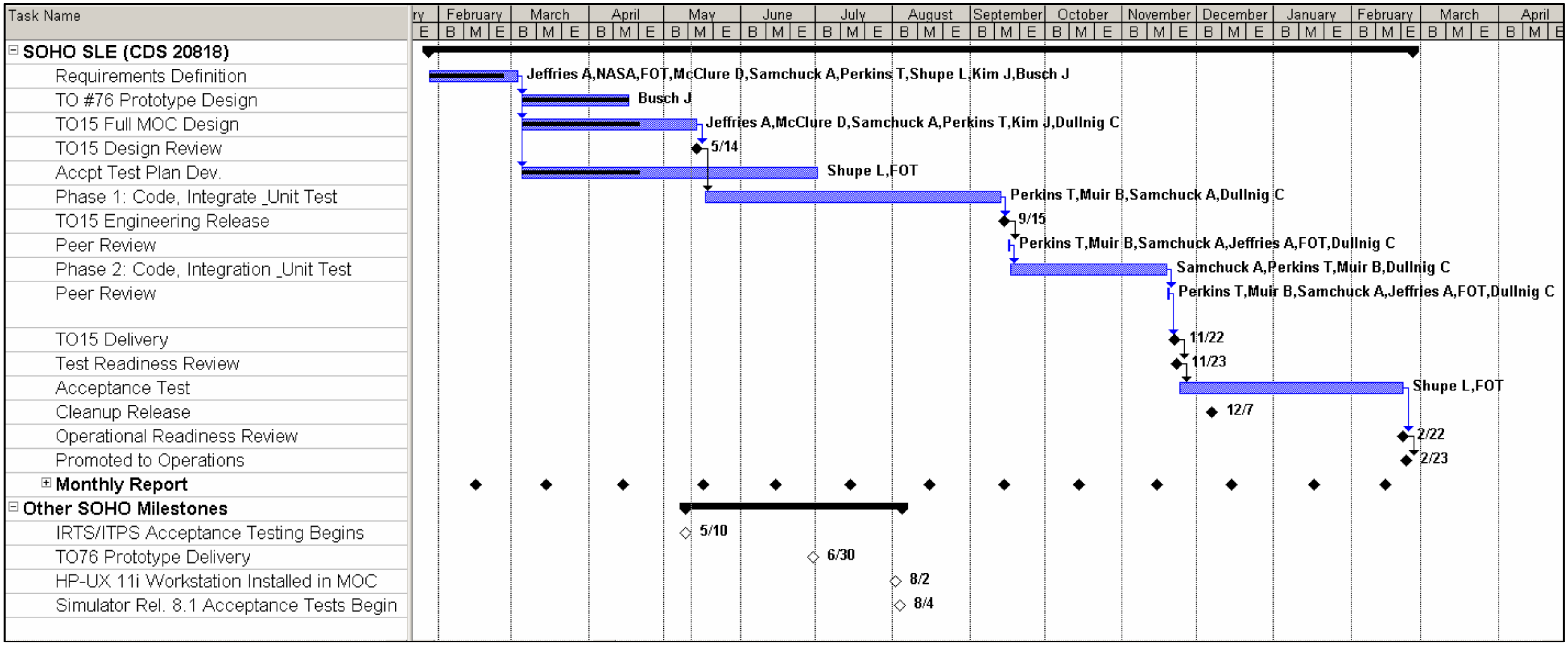
Software Development Schedule and Milestones



*** Full Featured SLE Delivery to the MOC for Acceptance Testing Projected for 23 November 2004**

Acceptance Test Phases

Phase 1: Testing with the PTP or SOHO Simulator

- This test phase will locally verify all operational scenarios and procedures.

Phase 2: Testing with the DSN

- Testing with DSN Test Facility (DTF) 21 – Interface Test for Receiving Replayed Telemetry
- Testing with DTF 21 – Interface Test for Command Receipt
- Testing with the DSN Ground Stations – Interface Test with Goldstone, Canberra, and Madrid for telemetry
- Testing with the DSN Ground Stations – Commanding
- Testing with the DSN Ground Stations – Station Handover (telemetry and command)

Phase 3: Testing with New Norcia

- Testing with ESA ESOC reference station – Interface Test for Receiving Replayed Telemetry
- Testing with ESA ESOC reference station – Interface Test for Command Receipt
- Testing with New Norcia – Telemetry
- Testing with New Norcia – Commanding
- Testing with New Norcia and DSN Ground Stations – Station Handover

SSMO Bulk Buy (USN)

- SSMO exploring business case of brokering a commercial bulk buy via a NENS Task Order
- Leverage purchase power of multiple missions to provide a flexible capacity to be shared as needed at an overall reduced cost
  - FUSE, TIMED, GALEX, and Swift have existing USN contracts
  - THEMIS will use UCB antenna but need additional support
  - Gathering data from other near-term space science missions
  - Evaluating feasibility of off-loading DSN 26m LEOP and contingency support

Searching for Win-Win amongst SSMO, USN, GN, and NENS

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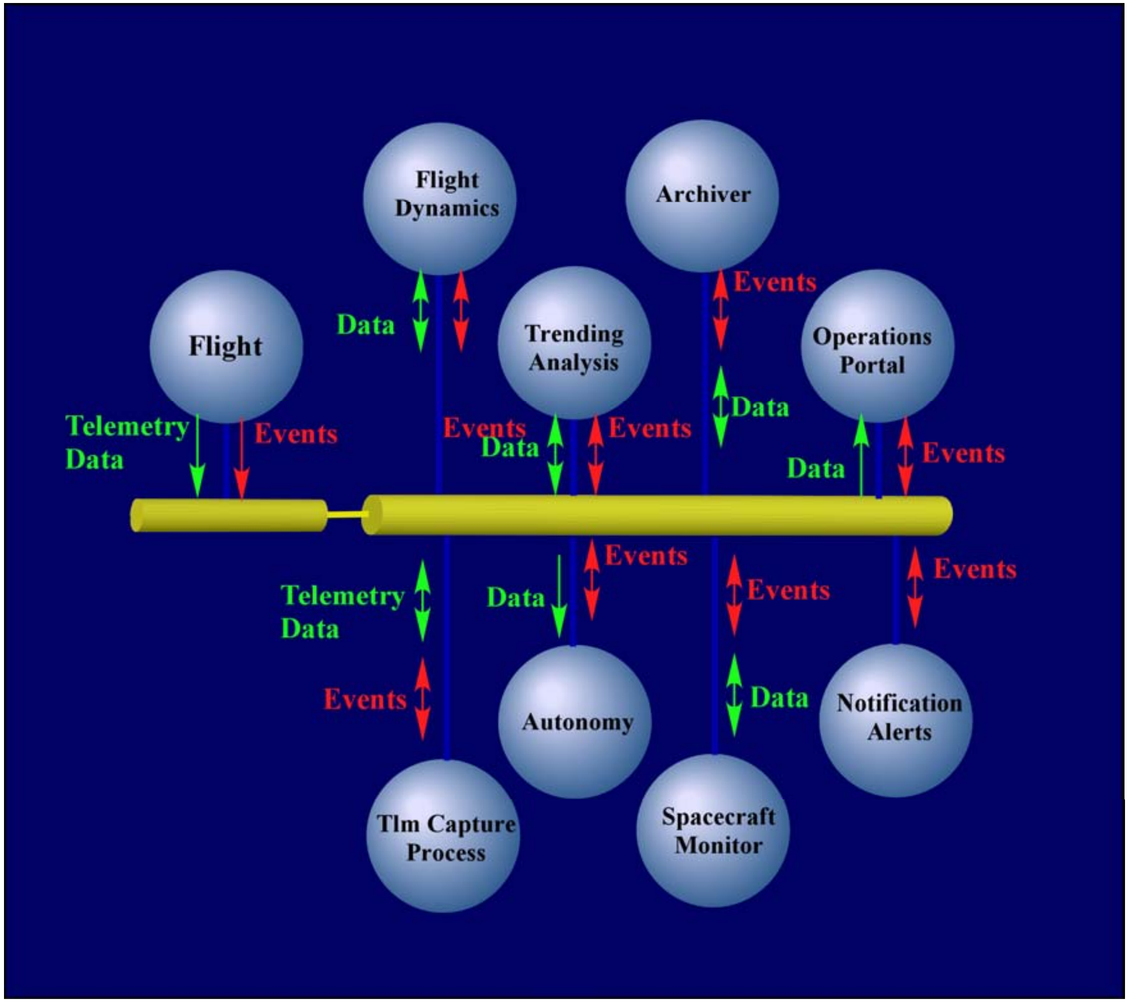
GMSEC Reference Architecture



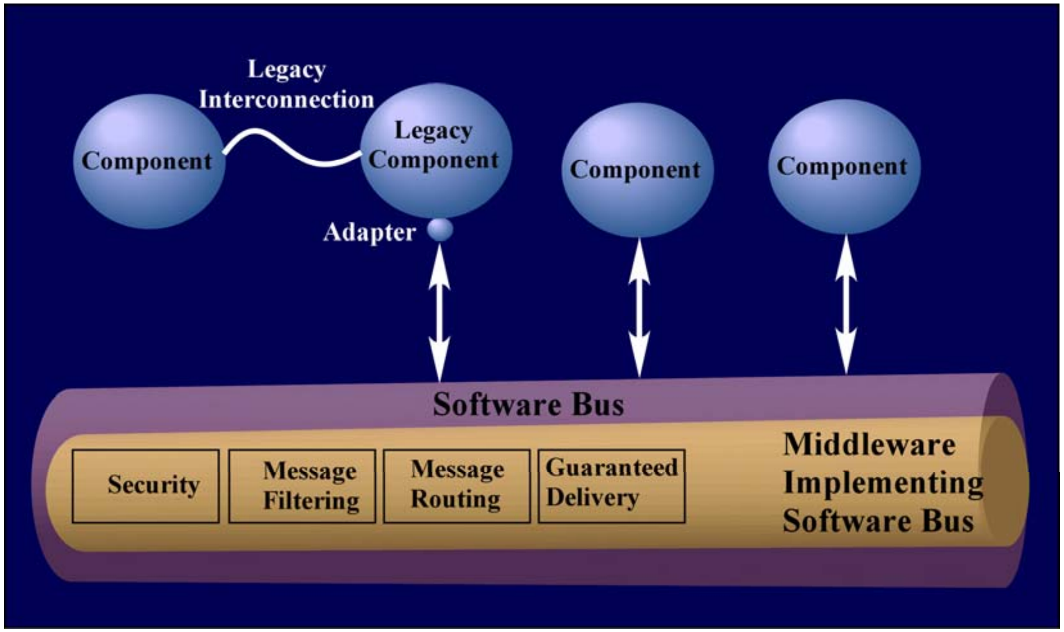
~ N^2 problem vs 2 * N problem

Why Standardize Key Interfaces?

Standardization of components allows for a high level of reuse as multiple missions utilize the same tools. Over time, however, these tools may become stale, new requirements may go unmet, improved options may become available, and new missions may have different preferences.

Standardization of interfaces creates an environment where new tools can be added over time, obsolete components can be replaced, and new missions are not bound by component selection decisions made many years earlier. Technology advancement can be made incrementally and the impacts of product vendor failures or new requirement are minimized.

GMSEC Software Bus



GMSEC Architecture Features

The Reference Architecture features include plug-and-play components, standard messages, and the software information bus.

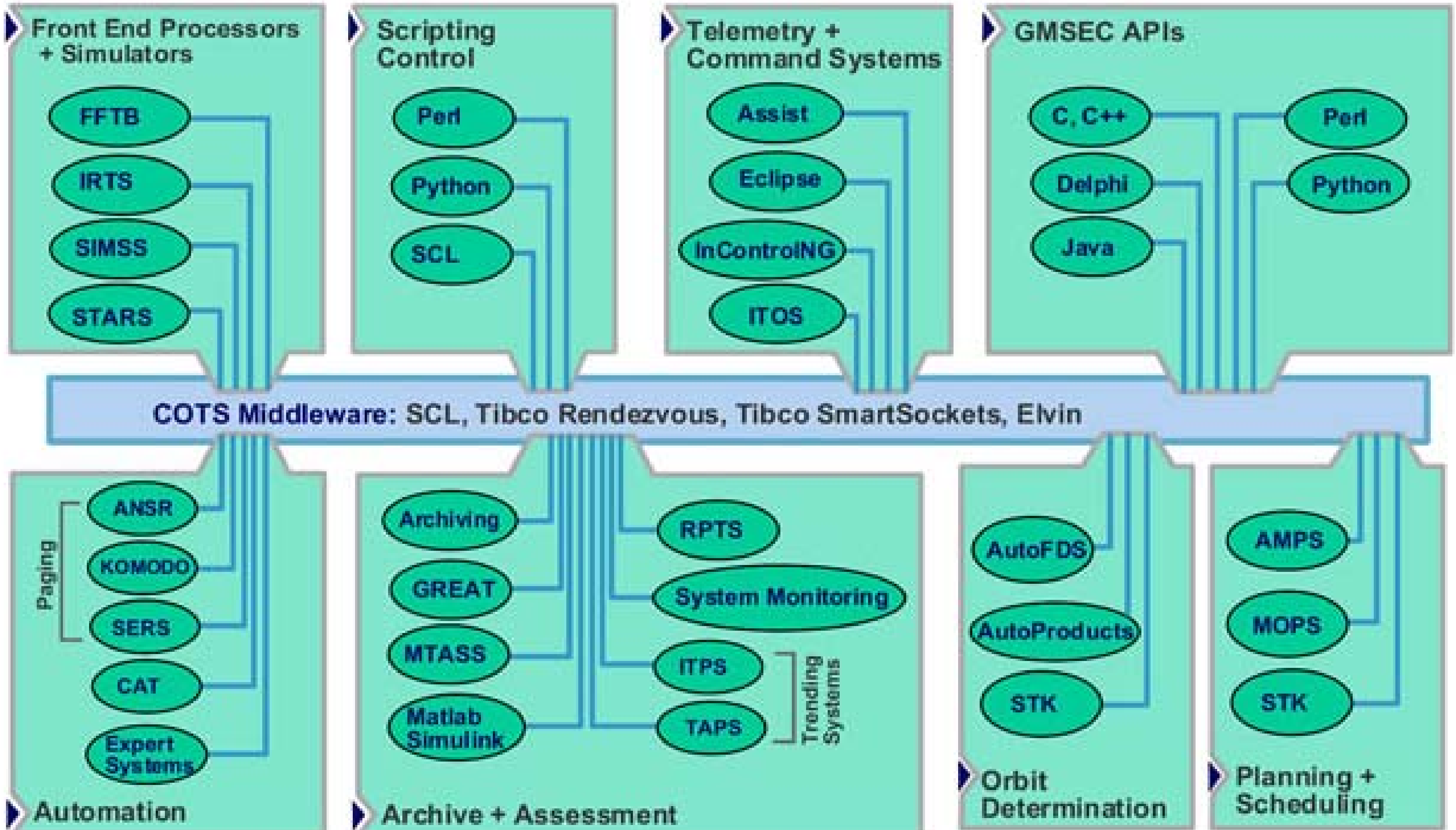
Components can be core functional applications such as Telemetry & Command, Planning & Scheduling, Assessment & Archive, Guidance Navigation & Control, and Simulation & Modeling or new stand-alone functions.

The components publish/subscribe to the information bus using standard messages.

The GMSEC Applications Programming Interface (API) shields the components from dependencies on communication protocols, operating systems, and hardware platforms thus facilitating platform transparency for the components.

Legacy components interface to the Software Information Bus using adapters.

GMSEC Architecture Continues to Mature



Four middleware choices and over 20 functional components and are now integrated into the GMSEC architecture. Missions can select among them to build mission control systems.

GMSEC Status

- **Program Activities**
  - Following GMSEC participation at the 2004 Ground System Architecture Workshop (GSAW) they have been contacted by a number of organizations interested in learning more about GMSEC and the possible sharing of components. Groups include NOAA, JPL, Raytheon, PanAmSat, and Orbital Sciences Corp. GMSEC's obligation to support outside organizations needs to be defined. GMSEC held a follow up meeting with NOAA and reported that there was a lot of interest. A demonstration for NOAA was to be done in May.
  - Met with APL and exchanged information about MAKO (their new architecture) and GMSEC's architecture. There are some interesting potential leveraging and some parallels in approach. Will probably pursue a joint FY05 development effort focused on putting their modeling and automation on the GMSEC bus
  - Collaborated w/ MSFC and submitted to the Code T H&R Technology call.
- **System Development**
  - SSMO is implementing a GMSEC architecture approach to demonstrate fleet operations using the Small Explorer satellites. Key elements of the demonstration are the use of a COTS multi-mission T&C system, use of GMSEC components in a fully integrated multi-mission environment, and back-up support to a University operations team